



POLICY INSIGHTS

Thinking ahead for Europe

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The Internet and Jobs

A giant opportunity for Europe

William Echikson

Summary

Over the past two decades, digitalisation has unleashed deep-seated fear among workers for the future of their jobs. Many of our daily activities, from entertainment to shopping, are being transformed. Uber drivers replace taxi drivers, artificial intelligence programmed legal review software replaces lawyers, and robots replace blue-collar manufacturing workers. Some studies predict that digitalisation and robotisation will cause job losses up to 50% of all jobs over the next few decades.

Yet new research argues that such assertions are mere fear-mongering and that in reality the internet is creating more jobs than it destroys – and that these new jobs are better paid and less physically strenuous than their predecessors. Although most studies look at the United States and still need to be ‘Europeanised’, this optimistic view of future work suggests that this technology-fuelled job creation is not limited to tech hubs such as London and Berlin, but is moving quickly into provincial cities and is even reaching into the hinterlands long dominated by traditional industries such as coal, steel and farming.

The internet reduces distances. By allowing access to the world with a few clicks, it lowers barriers to entry and gives provincial and rural dwellers new opportunities to communicate, engage and reach a global market. Thanks to the new sharing economy, it permits immigrant and marginalised populations to re-join the workplace. And finally, digitalisation powers new personalised manufacturing, opening the horizon to repatriating lost factory jobs from Asia to Europe.

The full benefits of the digital transformation only will be achieved if correct policies are implemented. Our key recommendation is to enable, not to try and stop the digital labour market revolution. Policymakers should resist giving into incumbent interests who want to protect their privileges. If anything, they should speed up the rate of creative destruction in order to raise living standards for all.

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global community of chapters and members, it supports internet-led innovation, promotes the use of best practice technologies and encourages the adoption of policies enabling universal access to a globally connected, trusted internet.

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The Internet and Jobs: A promising opportunity for Europe

William Echikson

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Introduction

Despite evidence that globalisation and robotisation have increased inequality and left entire regions behind, new research shows that the move of economic activity to the internet is beginning to pay off in more jobs than it destroys. If anything, digitalisation is proceeding too slowly and is still limited to only a few sectors of the economy. The faster it moves, the faster will be the creation of high-paying jobs, for both white and blue-collar workers.

This paper opens with a historical comparison with the late 19th and early 20th centuries. Rapid industrialisation then boosted overall growth and generated many high-paying middle-skilled jobs. Governments built successful social security systems to manage social turmoil and help those left behind.

Today, we see similar phenomena. Digitalisation is boosting employment in e-commerce and is generating a large number of job-creating startups. Surprisingly, too, the content, pay and locations of these new jobs are often superior to those of the jobs they replace.

As case studies, we take a close look at the job transformation in the retail sector and the job-creation internet infrastructure. Brick-and-mortar sales jobs are declining, but they are more than made up for by visible growth in new e-commerce logistics jobs. The construction of giant data centres to handle internet data is booming. Both growth sectors are locating in traditional, hard-hit industrial areas.

New types of independent employment are also quickly increasing, from Uber drivers to Airbnb landlords. While it may be necessary to level the playing field with traditional taxis and hotels, the new sharing economy is increasing the size of the pie, producing more employment for often-marginalised job seekers.

The lesson for policymakers is clear – do not protect traditional industries. Accompany change by smoothing out disruption. Protect workers, but not specific jobs. Change is coming and it can be beneficial for boosting the labour market.

1. Reviewing the historical record

Think back to the United States in the early 1900s. The pace of technological disruption seemed astounding. Electric lighting, elevators, the telephone, the record player were being introduced. Railroads had revolutionised travel, only soon to be overshadowed by the rise of the internal

combustion engine and the automobile. Blacksmiths were going out of business. Mass production was generating widespread fear of massive job losses.

Instead, the arrival of the assembly line introduced a new era of prosperity. In 1914, Henry Ford doubled the daily wage for workers at his Highland Park factory to \$5 per day. Car production soared. The cost of a Model T plummeted, from \$950 in 1908 to \$360 in 1916. As Michael Mandel (2017a) of the Progressive Policy Institute writes, “Ford’s combination of high productivity, high wages, and low prices attracted both workers and customers and enabled Ford to create jobs at a spectacular rate.” Ford went from 14,000 workers in its Highland Park factory outside Detroit in 1914 to 36,000 workers in 1917. By 1955, Ford employed more than 180,000 workers.

Over that same period, General Motors went from 86,000 employees in 1919 to more than 600,000 workers in 1955. General Electric went from roughly 50,000 workers in 1914 to 215,000 four decades later. “As these firms expanded their workforce”, Mandel (2017a) writes, “the net effect was to replace low-wage jobs with jobs that offered middle-class incomes, lifting real earnings and living standards for the country as a whole. By 1955, factory workers came to epitomise the American middle class.”

Does this virtuous paradigm hold for the new digital age?

Yes, also according to Mandel (2017a). In comparing the job creation of these big industrial companies of the early 1900s and today’s tech leaders, he finds that the newcomers are creating jobs even faster than their predecessors, and notes that “Amazon, Apple, Google, Facebook, and Microsoft are creating jobs at a historically rapid pace”. According to his research, Amazon outpaces 20th century employment engines Ford and General Electric and in particular, “has reached 300,000 jobs faster than any other company in U.S. history”.

The growth shows no sign of letting up. Amazon promised in January 2017 to add 100,000 full-time workers in the United States over the next 18 months. Google expanded its workforce by almost 17% in 2016 alone. In the next section, I will examine the explosive growth of Amazon’s logistics warehouses.

Additional research suggests that the present labour market is not as volatile as imagined. Although many assume that US workers are more concerned about losing their jobs than their fathers, Robert Atkinson and John Wu (2017) of the Information Technology and Innovation Foundation report that 47% of workers felt their jobs were secure in 2014 compared with 59% in 1987. By historical standards, job security is on the rise. After examining the last 165 years of American history, these same authors conclude that new digital jobs are destroying few old jobs: “Levels of occupational churn in the United States are now at historic lows,” they write. “The levels of churn in the last 20 years – a period of the dot-com crash, the financial crisis of 2007 to 2008, the subsequent Great Recession, and the emergence of new technologies that are purported to be more powerfully disruptive than anything in the past – have been just 38 percent of the levels from 1950 to 2000, and 42 percent of the levels from 1850 to 2000.”

The explanation is surprising. It seems that digital innovation is driving less change today than industrial innovation did in the past. The computer may be everywhere, but its ability to destroy jobs remains quite modest. Giant, growing job-creating sectors of the 21st century economy such as education and health remain almost unaffected. Computers are not replacing teachers and nurses. When looking at the jobs in occupations that experienced absolute losses over a decade, Atkinson and Wu (2017) observe that the decade with the highest rate of loss was the 1940s, when almost 9% of jobs were in occupations that experienced absolute losses. In the 20th century, these losses averaged 5.9% per decade. Since 2000, the churn rate has slowed to 4.1%.

Critics ask: Is this relative tranquillity just the calm before a coming storm of robotics and artificial-intelligence-driven job destruction? Probably not, the optimists answer. Consider the warning sounded repeatedly by the World Economic Forum Director Klaus Schwab that robotics and artificial intelligence will destroy five million jobs by 2020. This sounds like a lot of destruction and not much creation, but Atkinson and Wu note that it adds up to the elimination of just 0.25% of jobs annually for next five years – “barely a rounding error”.

What about wages and living standards? Will they take a hit? Let’s take a quick historical look. During the first half of the 20th century, Mandel writes that Ford, General Motors, General Electric and other industrial giants in other countries created hundreds of thousands of jobs while rising productivity allowed them to pay good wages and offer consumers low prices. A new middle class of factory workers could afford to buy the products they made.

In the internet age, sceptics worry that the same virtuous circle is failing to be reproduced, that digital companies are creating hundreds of high-skilled computer programming jobs and thousands of low-wage, temporary positions. In richer countries, [The Economist](#) reports that inequality has increased in recent decades: between 1990 and 2010 the rate of economic convergence across American states is half what it had been between 1880 and 1980. Rich cities pulled away from poorer ones.

The main reason seems to poor productivity growth in poor regions. Globalisation allowed low-wage workers in the developing world to “take away” their jobs. Workers in the developing world grow richer while workers in rich countries get poorer. Although technology is the crucial determinant for productivity, and the internet represents a revolutionary new technology, most countries have not experienced growth rates in labour productivity exceeding 2% since the turn of the millennium.

A heated debate among scholars has attempted to make sense of this curious phenomenon. Some point to structural issues (e.g. an aging population) and others to cyclical causes (e.g. weak demand). The other possible explanation is, as suggested before, that the information revolution has so far mostly impacted digital industries such as entertainment, communications and finance, which are only a small share of the economy. As digitalisation spreads to services such as education and healthcare, productivity growth could accelerate, filling in the missing

middle of mid-level skilled, high-paying jobs. Mandel (2017d) argues that rising productivity “will raise wages across the economy and rejuvenate the middle class.”

So far, Atkinson and Mandel have been unable to extend most of their research to Europe. One must imagine that digitalisation in Europe trails that of the United States, making the potential upside even more attractive. European unemployment remains almost double the level in the US. Even so, Europe’s falling unemployment figures offers some bright hints of progress. This year, unemployment in the eurozone has dropped to 9.1%, down from 10.1% in 2016, and its lowest level since early 2009. Throughout the entire European Union, unemployment now stands at 7.7%, down from 8.6% a year earlier, according to [Eurostat data](#). Some of the fall is due to a cyclical upturn, but some of it is due to digitalisation dripping into the economy. Where are the new jobs being generated?

2. E-commerce and jobs

Bethlehem, Pennsylvania is Trump country, a region devastated by the closure of steel mills. Two decades ago, the last mill shut its doors, and with it, the hopes of many in the area of ever again getting jobs that paid good wages for physical work.

But today, on and near the old mill site, the New York Times reports that a fast growth of boxy, anonymous-looking logistics warehouses are rising for Amazon, Walmart and other e-commerce companies. E-commerce customers demand fast delivery. As more and more sales move online, delivery warehouses are adding stockers, pickers and packers at four times the rate of overall American job growth. This trend is powering a jobs boom for the children of the former unemployed steel workers. These jobs are stable and full-time, paying more than regular retail sales positions and require only a high school diploma and industrial worker skills.



Amazon logistics warehouses are giant job creators, more than making up for job losses in brick-and-mortar retailers.

E-commerce warehouses require cheap land – and a central location with good transport connections. This requirement rules out city centres and puts fringe locations at a disadvantage. But it embraces the heart of impoverished Appalachia, rural Indiana, Kentucky, Tennessee and Pennsylvania. Bethlehem is flanked by Interstate 78, less than 85 miles (200 kilometres) away from New York City and less than a day’s drive from seven other states.

Warehouse employment in a two-county area that includes Bethlehem jumped to

15,200 in 2017, from 5,200 in 2010, according to the New York Times article. Walmart has two huge facilities in Bethlehem. FedEx is building one of its biggest ground locations in the area,

and United Parcel Service opened a new hub near the New Jersey border last year to handle the torrential volume of traffic coming through eastern Pennsylvania.

Michael Mandel has investigated the larger retail market in the United States. While he found a small decrease in brick-and-mortar retail jobs from 2009 to 2016, the rise in new e-commerce warehouse positions more than offset these losses. In total, he estimates that e-commerce jobs in fulfilment centres and e-commerce companies rose by 400,000 in the past decade, substantially exceeding the 140,000 drop in brick-and-mortar retail jobs. The unemployment rate for the 10 'heartland' states – Illinois, Indiana, Iowa, Kansas, Michigan, Minnesota, Missouri, Nebraska, Ohio and Wisconsin – has fallen to 4% this year, from a high of 10.3% at the end of 2009.

These are well-paying, good jobs. At the Pennsylvania warehouses covered in its recent story, the Times reports that workers receive health insurance, paid time-off and a 401(k) retirement plan. The average warehouse worker in the area earns \$14.46 an hour, compared with \$12.67 for those in retail sales and \$10.85 for waiters. Overall, Mandel estimates that fulfilment centre jobs pay 31% more, on average, than brick-and-mortar retail jobs in the same area.

Warehouses are colour-blind. In brick-and-mortar retailing, most salesmen and women are white, and Hispanics and African-Americans participate less than their ratio in the overall population. In e-commerce fulfilment centres, the racial balance matches the overall population. Women are shunted into low-paying sales jobs, where they outnumber men by 60 to 40%. In e-commerce warehouses, men outnumber women, 60-40.

What about robots? Machines have begun to take on some of the tasks involved in getting goods to people within one day of a click. Amazon workers report affection for the robots, which do much of the heavy lifting and some of the more monotonous tasks in their jobs. Although automation may slow the growth of the e-commerce logistics jobs motor, there is still a lot of gas left in the pump. As of the new first quarter of 2017, e-commerce still accounts for less than 9% of retail sales. But as online sales grow, so too will the demand for workers, even robot-aided workers.

This e-commerce jobs motor still needs to be studied in Europe. While Amazon has dozens of warehouses spread out across the United States, it reportedly has similar centres in Europe in two countries - the UK and Germany. It is now also building new facilities in Poland and Slovakia and seems set to spread out through the continent.

The expansion has been far from painless in unionised, welfare-state Europe. Since 2013, German labour unions have organised frequent strikes at Amazon's nine German warehouses. They are pressing demands for the retailer to raise pay for warehouse workers in accordance with collective bargaining agreements in Germany's mail order and retail industry. According to Stefanie Nutzenberger, the leader of the Verdi union, "constant checks, heavy workloads and physically stressful activities lead to an extreme strain on the workforce, which is especially evident in the Christmas business" (see Reuters, 2016). Amazon has repeatedly rejected the

union's demands, saying it believes warehouse staff should be paid in line with competitors in the logistics sector, not as retail staff.

3. The data centre revolution

Six decades ago, the famed Finnish architect Alvar Aalto built a stunning red-brick paper mill in Hamina, a small town of little more than 20,000 in south-eastern Finland. The millennium brought hard times to the region's paper industry and Aalto's paper mill closed in 2008.

The next year, Google bought the facility. Over the last decade, the search giant has transformed it into a modern data centre, literally jumping from the industrial to the digital age. A good comparison is with electricity. When this new source of power was first developed, everyone believed they needed his own generator – few imagined it safe to 'outsource' this crucial piece of infrastructure. Similarly, when computing first emerged, the initial instinct was to store one's own data, on hard disks or individualised servers. Eventually, giant power plants proved the best way to distribute electricity and giant data centres are now proving the best way to store and distribute data.

A data centre filled with computer servers acts as the heart of the internet's circulatory system. Just like the heart pumps blood through the body, data centres pump out data to users. Data centres are not homes just to stacks of computers. They are also employment hubs, home to the 'unsung heroes of the internet', the men and women who run the data centres.



Google's giant data centre in Hamina, Finland has been a giant construction site for more than a decade.

For competitive secrecy and security, Google released little information about its operation in Hamina. For outsiders unable to enter, it resembled a high-security prison. Locals underestimated the size of the investment. Few jobs seemed to be created, few local companies secured contracts and the main impact seemed limited to filling the city's hotels and bars with foreign workers. The idea spread that Google would only be hiring PhD computer scientists – or that a majority of jobs would disappear at the of construction.

When the Google facility became operational in September 2011, and the company released the true figures, they came as a surprise. More than 2,000 individuals working for 50

companies, contributed to the project. Construction continues even today. Some 125 people are currently employed at the data centre in full-time and contractor roles across engineering, technical work, security, food service and buildings and grounds maintenance.

Finland's economy is facing severe challenges. The country's traditional paper industry has largely moved offshore and is contracting. Its flagship technology company Nokia has lost its mobile phone leadership, while sanctions are reducing sales to the important Russian market. Since the beginning of the century, more than 20,000 forestry jobs have vanished. In the past six years, the country's tech industry has shed 40,000 jobs, with 14,000 layoffs alone caused by the implosion of Nokia.

In the midst of these developments, digital infrastructure stands out as a rare bright light. Google's €800 million data centre in Hamina represents the largest foreign investment in a greenfield project in the country. Microsoft, Yandex, TeliaSonera, Atos and TelecityGroup have also built or are building data centres in Finland. According to Oxford Research, the Finnish data centre cluster could create an estimated 32,000 to 50,000 years of employment over the next decade and create a total economic impact of €7-11 billion.

Like in Finland, big data centre investments often are concentrated in areas first powered by traditional industries that now face economic structural change. Like the industries of an earlier era, data centres require cheap land, plentiful energy supplies and nearby water for cooling. These are the same inputs for producing paper, mining coal and making steel. Google's St. Ghislain facility in southern Belgium sits in the heart of a traditional coal mining region. Microsoft's Dutch data centres release enough heat to power giant neighbouring greenhouses.

Skills used in traditional industry often can be reused for this new digital infrastructure. Data centres do not require coders with PhDs. They require security guards, electricians and cabling. A basic knowledge of Linux software may help, but is not a must. This is physical work, replacing hard disks and computer wiring. At the Google plants in Finland and Belgium, good English-language skills are the basic barriers for most job seekers.

Throughout Europe, the data centre opportunity remains in its infancy. As the world goes online, the amount of data being generated is expanding exponentially, creating a huge increase in required digital infrastructure. Five years ago, eight hours of video was being uploaded to YouTube each minute. Today, it is 300 hours a minute. More than 250,000 words – two and a half books – are published on Google's Blogger platform per minute. Some 1,000 million websites are now up and running. By the end of 2020, some 50 billion devices will be connected around the world, double the number today. Powered by this explosion in data flows, global data centre demand is expected to increase exponentially, with 60 new large data centres expected to open in Western Europe by 2020.

Overall, the data centre opportunity is more capital than labour-intensive, and employs far fewer workers than e-commerce logistics centres. In order to benefit fully, Europe must complete its digital single market. Despite Google's investments in Finland and Belgium, Data Centre Dynamics reports that two-thirds of all data centre investment is headed for the countries with

the highest energy and land prices in the EU: Germany, the United Kingdom and France. Why? Data localisation laws – or the perception of restrictions – seem to be the main reason. Germans want their data stored in Germany, even though it enjoys the same legal certainty if stored in Finland.

The European Commission has responded this autumn by proposing a new law enshrining the “free flow of data” throughout the European Union. If approved, this free flow non-personal data across borders will mean that it will be the same, legally speaking, to store data in Finland or France, or indeed anywhere in the 28 nation European Union. The European Parliament is now beginning to consider the proposal. This is an important initiative and will allow cloud providers to build big, efficient facilities in the most economic locations.

4. Uberisation and a second chance

The warehouses and data centres behind the internet economy are havens for those seeking a second chance. In Bethlehem, Pennsylvania, the New York Times profiled Bronx-born former drug dealer Omar Pellot. In and out of jail as a teenager and incarcerated for a year on Riker’s Island as a 17-year-old, he eventually moved to the Lehigh Valley, where he got a job at Amazon almost immediately. When the company asked about his background, he said, “I explained it to them — you know, I was young and naïve and stupid.” In a year as a picker — retrieving items from vast shelving units — Mr Pellot said he received two raises that pushed his hourly pay to \$14.30. He passed a test to become a forklift driver and has his sights set on becoming a supervisor.

The sharing economy offers similar paths out of poverty. In the impoverished Paris suburb of Bobigny, the Financial Times (2016) published a profile of French-Arab Baba (he goes by his first name) who drives for Uber. A high-school dropout, Baba started to slip into petty crime in his teenage years. At 17, he was sentenced to four months in prison for a robbery. When Uber had rolled out its ride-hailing app in France a friend who had started a mini-cab company using Uber’s technology offered Baba a job as a driver and a judge let him out early under judicial review. Since then, Baba has been working 10 to 12 hours nightly, six days a week. In 2014, he

gained a licence to operate his own chauffeur service. “Without this job, maybe I would be in prison,” Baba says, laughing as he drove his Peugeot 508 to a garage through rundown rows of small houses.

Paris’ northern suburbs are home to thousands of undereducated youngsters like Baba. In Bobigny, joblessness stands at 22%, double the national rate. More than a third of those aged 15 to 29 are unemployed. Uber and other platforms are challenging the Parisian taxis’



Uber creates work for immigrants and minorities who otherwise find it difficult to enter the job market.

monopoly to create more than 15,000 jobs. They compete against the 17,000 taxis in Paris.

A French driver study by [Landier, Szomoru and Thesmar](#) found that 25% of French Uber drivers had been unemployed before driving, 40% of those for more than a year. A 2016 Boston Consulting Group (BCG) study also found that in the first half of 2016, a quarter of all new employment opportunities in Paris came from platforms like Uber.

Independent work is popular. McKinsey recently published [research](#) on independent work, showing that 20 to 30% of the working-age population in the United States and Europe, or up to 162 million individuals, engage in independent work. Those who choose to work independently are happier and more satisfied in their work than those in traditional jobs. A UK [poll](#) of Uber partner drivers by ORB which looked at demographics and motivations, found that 94% say: “I joined Uber because I wanted to be my own boss and choose my own hours.” Some 88% reported that their incomes have increased or stayed the same since joining Uber.

Perhaps the most important impact of France’s Uberisation is the opening up of the country’s sclerotic jobs market. Charles Boissel, a PhD student at HEC Paris, a business school, found that most minicab registrations were in the “suburbs of northern and south-eastern Paris, where economic conditions are harshest”. After Uber agreed to partly open its database, Augustin Landier, professor at the Toulouse School of Economics, and David Thesmar, a professor at HEC, conducted the first detailed survey of Uber drivers in France.

According to their findings, provided to the *Financial Times*, some 98% of drivers are male; they are much younger than established taxi drivers (70% are under 40, compared with 30% for taxis), and more have experienced unemployment (a quarter were jobless before turning to Uber, and nearly half of those for more than a year). Unlike US drivers, who tend to use Uber to add to their income, 81% of French drivers have no other job. Two-thirds say they want “to start a new long-term career”. One-fifth work more than 40 hours a week. Most earn €20 an hour, more than twice the minimum wage.

[Another striking finding](#) is how ride-sharing provides services in areas previously without taxis or with few taxis. In California, Uber first took off in the four largest census-defined urban centres – Los Angeles, San Francisco, San Diego and Riverside-San Bernardino – where over half of Californians live. But the Uber service has rapidly expanded outside of the largest population centres. In 2017, riders took trips in Fortuna (population 13,000), Gridley (8,000), and Mecca (11,000). In May 2013, Uber served only 17 urban areas, of which only one area had a population under 30,000. In May 2017, Uber has grown to serve 172 areas, of which 102 areas have populations under 30,000.

Yet, far from everyone loves Uber. When the company opened its services in Paris and other European cities, taxi companies resisted. In France, angry protests broke out and Uber drivers were attacked. Two Uber executives were detained by police and are being tried in Paris on “complicity in the illegal exercise of the taxi profession”.

Do the Uber drivers take jobs away from traditional taxi drivers? A Carl Frey [study](#) from Oxford looked at the employment impacts of Uber in the US and found that that “total employment expanded in cities where the Uber platform was adopted” and concluded that “our estimates cast doubt on efforts made – in parts of Europe and elsewhere – to ban or restrict the proliferation of Uber”.

Governments may need to smooth the path from traditional taxis to new ride-sharing apps. Taxi drivers pay hundreds of thousands of euros to own city-issued taxi medallions. They might need to be reimbursed. Similarly, municipalities may need to ‘level’ the playing field by imposing certain hotel-like obligations on Airbnb landlords. But be careful. [Research from Uber](#) shows that the more restrictions and costs put on new independent workers, the less the positive impact on job creation.

5. Start-ups spread, Apps accelerate

So far, we have looked at the low-educated, manual sectors of the job market. What about high-education, brain-fuelled Silicon Valley start-ups? A recent [Kauffman Foundation](#) study in the United States showed that the fastest job growth comes from new companies, not old ones. For all but seven years between 1977 and 2005, the study shows that existing firms are net job destroyers, losing on average one million jobs net combined per year. By contrast, in their first year, new firms less than one year old add an average of three million jobs.

Europe is often viewed as a start-up laggard, running far behind the frontier-pushing United States and Asia. But appearances are deceiving. In fact, according to a [report](#) by the London venture capital firm Atomico (2016), European start-ups are now taking the lead in artificial intelligence, building new tech hubs and drawing investment from traditional industrial stalwarts. Last year (2016), a record-setting \$13.6 billion was invested in Europe’s tech sector, compared with \$2.8 billion in 2011.



Europe is doing well nurturing job-creating startups and mobile phone apps.

Traditional industries are awakening to the potential of tech. Two-thirds of Europe’s largest corporations by market capitalisation have made a direct investment in a tech company while one-third has acquired a tech company since the beginning of 2015.

Gone are the days when Europe’s “tech” sector was largely composed of consumer-oriented e-commerce businesses – often blatant knockoffs of successful US companies. Today, Europe is the home of real pioneering innovation, led by what Atomico (2016)

calls “deep tech” – the kind of artificial intelligence developed by Google’s DeepMind. Deep tech accounted for \$1.3 billion of European venture investments in 2015, delivered in 82 rounds, up from \$289 million, delivered in 55 rounds, in 2011.

Europe’s new tech hubs are emerging in unexpected places, far beyond the early hotspots of London, Berlin and Stockholm. Atomico pinpoints Paris, Munich, Zurich and Copenhagen as the cities to watch in the coming years. The French capital, Atomico points out, has already begun to challenge London and Berlin in terms of the number and volume of venture capital-financed deals.

Most important, this tech boom is turning into a jobs boom. Atomico estimates that Europe boasts today 4.6 million computer developers compared to 4.1 million in the United States. Data from LinkedIn show that tech firms created two times as many jobs in 2016 as the rest of the economy in most EU countries. The number of Irish employed in tech jobs grew five times faster than overall employment.

Another important area for European job creation comes from apps running on mobile and social platforms. Since the launch Apple iTunes App Store in 2008, the number of companies selling through consumer app stores has exploded. In his report of the phenomena, Mike Mandel (2016e) counts 1.64 million App Economy jobs as of January 2016 in Europe. The comparable number in the United States is 1.66 million App jobs, about the same in Europe. European companies have been able to take advantage of the global Apps Economy boom.

A European Commission funded report from Gigacom Research offers similar findings. Authors Mark Mulligan and David Card (Gigacom Research 2014) calculate that European developers took in EUR17.5 billion in revenue in 2013, and forecast that figure will increase to EUR63 billion in 2018. The EU app-developer workforce will grow from one million in 2013 to 2.8 million in 2018. Additional support and marketing staff result in total app economy jobs of 1.8 million in 2013, growing to 4.8 million in 2018.

How important is this job creation? Mandel notes that France has 229,000 App Economy jobs, only slightly less than the 289,000 net new jobs generated in the country between 2007 and 2015. By definition, no app jobs existed before the creation of the Apple store. Mandel calculated “app intensity,” calculating the App Economy jobs as a percentage of all jobs. The United States has an average app intensity of 1.2%. By comparison, Finland has a top place with a 1.9% app intensity.

The geographic spread of Apps employment around Europe is notable. Mandel ranked the top 30 cities in Europe for App Economy employment, finding London in the number one position with 136,000 App Economy workers, followed by Paris and Amsterdam. The Nordics also scored well, with Stockholm and Helsinki number six and seven. But Southern Europe is present as well, with Madrid and Barcelona in eighth and ninth position. Notable laggards are Austria, Hungary the Czech Republic and Italy. Their apps intensity was a mere 0.4%. Italy, a country of 55 million plus, only created 97,000 apps jobs over the past decade, only about two times that of Finland, a country of less than five million.

Conclusions

Europe is entering the new digital era paralysed by fear that it will destroy jobs. Instead, it should see the possibility of new positive horizons. Policymakers must take a deep breath and calm down. As Atkinson and Wu (2017) say, “labor market disruption is not abnormally high; it’s at an all-time low, and predictions that human labor is just one tech ‘unicorn’ away from redundancy are likely vastly overstated, as they always have been.”

This prescription does not mean that Europe must abandon its welfare state or eliminate job protection. More than ever, globalisation means that policymakers need to smooth the transition for those who lose their jobs. They need to encourage and stimulate the transition into new sectors and new jobs.

The political risk is real. Globalisation’s castaways have turned into populists around the Western world, propelling Donald Trump to the US presidency and the UK to Brexit. The populist threat on continental Europe remains strong.

But the overriding real danger for Europe’s future does not stem from technological change. Rather, it is imposing measures that slow down this change. Policymakers must not protect traditional industries or prevent workers from moving into new fast-growing industries. Instead, they need to encourage this movement, confident in the knowledge that it will lead to more employment and better employment than in the past.

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